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T H E S I S
FOR THE DECREE OF M.D.
on

OBSERVATIONS on the EPIDEMIOLOGY of SCARLET FEVER
AND CONCLUSIONS SUGGESTED THEREFROM

by

JAMES ALEXANDER RAEBURN, M.B., Ch.B., & D.P.H.

M.D. 1912.



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I have chosen the above as the subject of my thesis for the degree of M.D., because of some very instructive investigations that fell to be made by me, into epidemics of Scarlet Fever which occurred in different parts of the County of Dumfries during the latter half of 1910 and early months of 1911.

Each of the outbreaks which I shall describe was well defined, both as regards time and place; some of them occurred in up-country glens which are entirely occupied by sheep farms. In these glens the population is very sparse, and the movements of each person in the glen could be so satisfactorily remembered that the infective process could in some instances be traced from person to person, and every case of the disease accounted for, from the beginning of the outbreak till it was finally stamped out. Many of these cases of scarlet fever which thus came under my observation were mild cases; but in carrying/

ing out the Medical Inspection of School children, which is also one of my duties, the great importance of recognising and properly treating these mild cases has impressed itself on me.

These school medical inspections have demonstrated that many children take a long time to recover from scarlet fever. While some are quite well when the regulation six weeks have passed, others suffer from the effects of their illness for months. The chief of these after effects as revealed at the school medical inspections are anaemia, want of cardiac vigour, and feeling of tiredness in the class; and the teachers report that, especially amongst the infants, there is great bladder weakness which manifests itself in frequency of micturition.

I hope to shew in this paper that in every outbreak of scarlet fever it is probable that the mild and unrecognised cases far outnumber those which are notified and receive medical treatment, and just because they are unrecognised and untreated, they are more liable to be followed by the above mentioned sequelae than are treated cases. I am convinced that a great deal of ill-health in after life is the direct consequence of such overlooked scarlet fever in/
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in childhood.

One asks himself, "What is the cause of this state of affairs?" I believe the fault lies in neglecting to look for mild cases, and in paying no attention to "contacts". If these mild cases and contacts were sought out and made to disinfect themselves, I feel confident that much ill-health would be prevented. Besides entailing ill-health on themselves, these persons are the commonest agents in the spread of scarlet fever to others.

In the past, preventive measures have been confined too much to surroundings and too little attention has been given to the individuals.

ILLUSTRATION I.

I shall now describe the various outbreaks of scarlet fever in the investigation of which I made my observations, and from which I have drawn my conclusions. The first one I shall describe may be called the "Ericstane outbreak".

This outbreak occurred in a glen in the North East part of the County on the borders of Lanarkshire and Peeblesshire. The whole glen is let in large sheep farms. Many of the farmers are non-resident and practically the only inhabitants are the/

the shepherds and their families. There is a school taught by a lady, and about twenty pupils attend it.

About the middle of January, 1911, we received a notification of a case of scarlet fever in a girl in one of these shepherds' houses. I went up to make the necessary investigations and arranged to have the child removed to the isolation hospital.

Having done that, I set myself to trace the source of the outbreak and for that purpose visited the school to learn which children had been absent through illness during the past few weeks. All of these children I visited and was able to trace out a most complete and instructive history of the spread of the disease in that small community. There had been no previous case of scarlet fever in the glen for several years.

A boy - cousin to one of the shepherd's families - had come from Carlisle about two months previous to my visit to spend a few days with his cousins. Two months previous to his visit there had been scarlet fever in his home in Carlisle, but he had not had it. During his stay and after his return home to Carlisle, one after another of his cousins took slight sore throats or had slight attacks of/

of indisposition, but no one suspected scarlet fever, nor, indeed, at the time, was much notice taken of these indispositions, and the children mixed as usual with their companions and attended school. Two of them at the time of my visit had albuminurea.

On their returning to school an epidemic of the same type spread amongst the scholars and many of them had to be absent for a few days. These later cases were certainly of a more severe type than the early ones, but still no one suspected scarlet fever.

Then came the case of the girl originally mentioned as having been notified. At the same time several members of another family were absent from school and on my visiting them, I found them to be typical cases of the disease which no one could overlook or mistake. The date of the beginning of their illness must have been two or three days subsequent to the case of the girl I had come up about.

We arranged for the isolation of all the acute cases, and treated the contacts with gargles, nasal sprays and bathing, and no other cases occurred in the glen.

On making the Medical Inspection of that School six months later, the teacher informed us that she/

she had had more absenteeism during that interval than during any previous year. The absenteeism had been amongst those children who in the early part of the year had suffered from the mild "sore throat". Doubtless these had been cases of unrecognised and consequently untreated scarlet fever, and the frequent absenteeism was the result of the debilitating effects of the disease.

The instructive points in this outbreak are:-

(1) That a person can apparently be a "carrier" of infection for months. The boy from Carlisle had not to his knowledge had the disease, but he had been exposed to infection two months previously, and on visiting his cousins, gave them the disease. As no fever had been in the glen for years, these cousins had probably never been exposed to the infection before, and were very susceptible; and

(2) That the virulence of the infection may have to be very much increased by passing through several persons before it gives rise to typical scarlet fever. The early cases in this epidemic were so mild that no one recognised the disease, and not till it had passed on through several children did it become typical./

typical.

ILLUSTRATION II.

Another case in the neighbouring County of Kirkcudbright came under my observation during the summer of 1911.

Two brothers, aged respectively six and four years, lived in an isolated house and were not coming in contact with strangers. They were particularly healthy boys.

In the Spring of 1911, the elder brother commenced going to school, and a few weeks afterwards complained of a sore throat.

Little notice was taken of this, no medical man was consulted: the sore throat was soon recovered from; and he all along occupied the same bed with his younger brother. The younger brother remained quite well.

Some three months afterwards, however, the younger brother got a drenching in the river, and this was followed by a chill. He was put to bed and for some five or six **days** occupied a bed by himself, during which time he progressed splendidly. Then his elder brother returned to sleep with him. Three days afterwards, the younger developed typical scarlet/

let fever.

That the slight sore throat which the elder suffered from was scarlet fever, I do not doubt. If that be allowed, then either one or other of the following sequence of events took place.

Either 1st, - The elder remained infectious for the three months, and when the younger was debilitated by the chill, passed on the infection to the younger;

Or 2nd, - The younger had the infection all the time, but not till he was debilitated by the chill was it able to develop scarlet fever.

In either case, one is forced to the conclusion that the infection may remain quiescent for months at least, and when circumstances become suitable, it may become virulent.

ILLUSTRATION III.

Annan Outbreak.

The next epidemic which I shall describe leads to much the same conclusions as the preceding, but the epidemic was on a very much larger scale. I shall call it the Annan Outbreak.

Annan is a town of about three thousand inhabitants. It is low lying near the Solway, and some parts have an inadequate fall for efficient drainage./

drainage. Like many of the Border towns, it contains a great many gypsies, tinkers, and hawkers. These people are nomadic in their habits, and pass much of their time "on the road". Usually some members of the family are at home and the others are away plying their vocation in different parts of the country. As can easily be imagined, the houses of these people are very unsatisfactory from a sanitarian's point of view. Many houses have only one apartment, and few have more than two. From their manner of life above described, it often happens that a great many members of the family chance to be home at the same time, and then overcrowding habitually takes place. And as has been shewn by many observers, nothing favours the spread of scarlet fever like overcrowding and uncleanness. The habits of these people are dirty. Few of the houses had water led inside. For both cooking and cleansing purposes it had often to be carried a distance, and that always means that the people use as little as possible for cleansing purposes, and for domestic purposes the water stands in an open vessel in the unclean apartment. Few houses had a sink. The privy accommodation was usually pail closets. A pretty extensive locality/

locality in the town consists of such houses occupied by such people, and it was in this part that the epidemic I am describing first broke out.

Throughout the first half of 1910 the town had been free of scarlet fever. During July a few cases were notified, but no anxiety was felt by the Public Health Officials; and there was nothing to foreshadow the serious epidemic that broke out in August and lasted for several months. The weather during that month was cold and wet, and probably induced more herding together in these small houses than would normally have occurred at that season. I consider it was this cold wet weather in August that determined the serious nature of the epidemic, not from any climatic influence on the germs of the disease, but simply because of the close herding together of these people that it induced. One of the conclusions I draw later on with regard to scarlet fever is that it is entirely a human disease, and that the conditions I have just described are the most suitable conditions for its spread and growth in virulency.

Early in August, after the cold spell of weather just mentioned, from a few scattered cases the/

the disease suddenly became a wide-spread epidemic. Notifications numbering two, three or four daily were made, and the type of disease was the most severe I have ever seen. Most of the cases were complicated by septic throats, many were scarlatina malignans, and the percentage of deaths was the highest I have ever seen; in the early days of the epidemic it reached nearly 20%, though fortunately, that high percentage was not maintained.

Besides the suffering entailed, the fever affected the ordinary business of the town. Merchants found that their customers were sending elsewhere for their supplies; and no Summer visitors came, which entailed a great financial loss on those who calculate on letting their rooms.

The Town Council were thoroughly roused to the need for making an energetic effort to stamp out the disease, and the duty of investigating and stamping it out fell to me.

On starting to make the investigations, one was at once struck by the severe type of all the cases, and from one's experience of such epidemics, one felt quite sure that there must have been earlier cases of a less severe type, of which there had been no/

no notifications.

The only efficient course to take was to make what amounted to a house to house visitation in that part of the town. This class of people never give the Sanitary Authorities assistance, but on this occasion they were thoroughly frightened by the severity of the fever, and they were less antagonistic than usual, and allowed themselves to be examined for signs of the disease. The labour entailed in examining so many people was very great, but the number of infectious people discovered was ample reward for our hard work.

A number of persons, both children and adults, and of both sexes, were found to be desquamating, and others, from the history one was able to elicit, had quite certainly had scarlet fever. Some of these had been ill in bed, but no medical man had been called in. These cases were strongly suspected to be guilty of wilful concealment and deserving of punishment, but it is exceedingly difficult to get satisfactory evidence for a prosecution, and no prosecution was instituted.

The more serious cases were removed to the Isolation Hospital, but it soon could accommodate no more, /

more, and the others were treated at home) and were supervised by the Sanitary and Public Health Officials.

After a fortnight, the notifications had decreased to such an extent that we began to congratulate ourselves that the epidemic was mastered. From that time onwards, however, for between two or three weeks, a puzzling series of cases kept occurring. One every second or third day continued to be notified; and no connection with previous cases could be made out. Also these were all boys ranging from eleven to fourteen years of age. Then the Sanitary Inspector noticed that boys of that age were in the habit of bathing together in the river, and he further noticed that one particular boy - J.M. - constantly bathed with them. No other boy constantly accompanied them. He had bathed with every one of those who had recently been notified. Not to his knowledge had this boy been ill, but I was asked to examine him.

I could elicit no history pointing to scarlet fever, and there were no physical symptoms discovered which in the ordinary course would have justified one in suspecting him to be a source of infection./

tion. There was no discharge from any of the mucous surfaces that we could discover; but we did see some very faint and doubtful desquamation from the soles of his feet.

I attached little importance to this desquamation, as I quite agree with the modern view that late desquamation in itself is not infectious. It was entirely because of his apparent connection with all the recent cases that I asked the parents to agree to his isolation. They arranged to have him kept in a room by himself for a week, and immediately on that being done, the cases ceased.

From the epidemiologist's point of view, there are several interesting points in this outbreak.

As in the Ericstane outbreak, there was the occurrence of mild cases at the commencement to which no medical man was called; then the spread to other persons, and the rapid increase in severity.

But the most interesting factor was the boy - J.M. Without having been ill himself, he was a "carrier" of infection, but only to those boys whom he came in contact with in the water. Taken in conjunction with the last case described, when the younger brother took the infection after having had a wetting./

wetting, it makes one look out for evidence whether some such combination of circumstances is necessary for the development of scarlet fever.

The modern view is that desquamation in itself is not infectious, at least in the ~~last~~ ^{later} stages and one frequently sees evidence that this view is correct. As an instance I accidentally discovered a boy typically desquamating, who was on a visit to some boy friends, and was occupying the same bed with a healthy boy. Neither his bedfellow, nor any of the other children in the house got scarlet fever. One wonders whether he would have passed on the infection if he had bathed with his companions.

ILLUSTRATION IV.

The next outbreak to be described I shall call the "Tubhill" epidemic.

It occurred in another up-country glen let in large sheep farms. The population is scattered, and there is the minimum of contact with strangers. There is a school in the glen to which the shepherds' children go, and many of them have to walk several miles to it.

In March, 1911, we received a communication from the Clerk of the School Board saying that, owing to/

to an outbreak of what was supposed to be "Mumps", the attendance at the school was down to about half of the usual number, and asking that some one might go up and endeavour to stop the further spread of the disease. I went up for that purpose.

Following my usual practice in such cases, I called first at the school to ascertain how much absenteeism from illness there had been during the previous few weeks, and to get the addresses of those who had been ill. That an infectious disease of a mild nature had spread amongst the children in the glen I was at once convinced, but neither from the description of the disease given by the teacher, nor on examination of the children when I visited their houses later on, could I convince myself that it had been "Mumps". Indeed, I felt certain that it had not been Mumps, but what it had been I confessed myself unable to say. It had attacked all the children in a family at a time, and in that way first all of the children from one household had been absent, and then all those from another.

Some of the children I examined were recent cases and were not yet recovered, while others had been/

been ill several weeks previously and were now quite well; but until nearly the end of my investigations none of them shewed any signs to indicate the nature of the illness they had been suffering from.

In the very last house I visited, one child had been absent from school for about a week; and another was absent for the first time the day of my visit.

The former had been feeling merely "out of sorts" without any definite symptoms, and it had not been considered necessary to call in the medical attendant; and when I saw him, he declared that he was feeling perfectly well again. On examining him, I found that the skin over the sub-clavicular regions peeled off when rubbed, very much in the same way that damp paper does. In hospital I have often observed that same kind of peeling in undoubted scarlet fever patients who shewed no other desquamation, and this made me suspect that it was scarlet fever which this boy and all the other children in the glen had been suffering from; but the parents resented the idea of the disease being labelled scarlet fever and refused to take any precautionary measures. So, however much I was convinced in my own mind that it was/

was scarlet fever, I knew that the evidence I had to offer was too indefinite to satisfy a Sheriff if the father disputed it; therefore I decided that I could not notify it in the meantime. This visit was made on Thursday.

A brother of this boy was at work in Dumfries and went home for the week-ends, when the two boys slept together. He came home the Saturday following my visit as usual, and returned to Dumfries on Monday. On Tuesday, he was taken ill with a severe scarlet fever. It proved a very bad case indeed. The parents now admitted that it must have been scarlet fever that the first boy had, and agreed to co-operate voluntarily with us. The boy first mentioned (with the indefinite ~~feeling~~) was found to have albuminurea, and was isolated at home.

Some other cases developed in the glen after this time and they were all of a rather severe type and easily recognised, but as no further difficulty was thrown in the way of the health authorities in dealing with them, the epidemic was soon stamped out.

This epidemic has several interesting features. In the first place, the early cases were mistaken/

mistaken for Mumps; and although the diagnosis was not made by a medical man, but by country women, I am prepared to believe that they must have resembled Mumps, for these women are wonderfully observant regarding illness.

In the second place, though I saw cases in all stages from early to late, I was unable to recognise them to be scarlet fever; but nevertheless, one of these mild and unrecognisable cases infected his brother with what proved to be a very severe attack of scarlet fever indeed.

There was no gradual increase in the severity of the disease such as was seen in the Ericstane and Annan outbreaks, but suddenly, from being mild and unrecognisable, they became typical and dangerous.

In this school, as in the one in the Ericstane glen, we found, when we did the Medical Inspection some months later, that these mild cases of scarlet fever had left sequelae in many of the children. There had been far more absenteeism than usual from debility, and some of the scarlet fever cases were found to be suffering from anaemia, breathlessness, weak cardiac action, and deafness. I intend to/

to emphasise it later on, but mention here that the mischief following unrecognised and consequently untreated scarlet fever is very great indeed.

ILLUSTRATION V.

My next illustration is not an epidemic, but a "series of cases" which have occurred at Cummatrees. This is a large arable farm where some six or seven married ploughmen are employed. These live in a row of cottages not far removed from the farm house, and together with the farmer's family, the unmarried servants, male and female, and the married ploughmen and their families, there is a little community of between thirty and forty people. Many of these are children and, of course, more susceptible to scarlet fever than are adults. About one and a half years ago the farmer's son took scarlet fever. He was a delicate boy and had already suffered from rheumatic fever, which left him with a weak heart. On account of being delicate, his parents were very averse to his removal to the Isolation Hospital, and he was nursed at home. It is a large house and the boy was as completely isolated as if he had been in the Hospital. It was a long illness and complicated with purulent discharges from ears and nose. Nearly/

Nearly three months passed before these discharges ceased, and he was allowed out of the house to mix and play with the other children about the farm. The house was carefully disinfected.

During the three months that he was lying ill in the house, not another case occurred at the farm; but immediately on his going about again, one of the ploughmen's children took ill, and at varying intervals ever since, cases have been notified amongst the cottagers' children. Long periods elapse without any cases occurring anywhere else in the neighbourhood, but they continue to be notified every little while from that farm.

In this case, unfortunately, neither the parents nor the medical attendant are in sympathy with the Public Health Officials, and no assistance is given to prove whether or not this boy is really the source of these cases. I believe he is, and quite look for cases continuing to arise at that farm so long as this boy is allowed to mix with the other children; but we cannot interfere.

I consider this an instance of a person remaining infectious for a much longer period than the six weeks which is popularly believed to be the limit/

limit of time during which a person does remain infectious. He had purulent discharges during his acute illness, but no such discharge can be detected now. Although the boy mixes freely and plays with about a dozen children, there has not been anything in the nature of an epidemic set up amongst them. Just one case at a time at intervals of six weeks or two months, but they continue to come.

In former years this would probably have been considered a case of "house infection". Before we knew that some persons can carry infection for an indefinite time, it would have been very natural to argue that the germs of infection must be living and growing somewhere about that farm; but now that carriers have been demonstrated, I consider we are justified in regarding this boy as a "carrier" whose infectiousness is intermittent.

ILLUSTRATION VI.

Crossford Epidemic.

The outbreaks I have already described are illustrations of how the disease gets imported into communities which have been exempt from it for a considerable time, and where consequently the young children are likely to be susceptible to the disease. Usually/

Usually in such instances the early cases are mild, and the mothers are not on the outlook for fever, and, consequently, it is not till the infection is widely spread and the type of the disease has become pronounced that it is diagnosed, and the Public Health Officials are notified of its presence, and can take steps to arrest it.

The outbreak I am going to describe now was accidentally discovered in its early stages and arrested before any serious cases had occurred. So far as I have been able to determine, there has been none of the resulting debility and bad health amongst the children in this school, such as has been mentioned as occurring in those schools where the disease ran a longer course before it was discovered.

Crossford is a school in the Western part of the County in a sparsely populated neighbourhood. Early in 1911 I went up to make the routine medical examination of the school. The teacher remarked that three children, all of whom lived at the same farm, had complained of headache and had been sick in school the previous week; but they were soon feeling well again, and no significance was imputed to the sickness. It was considered merely a "disordered stomach."/

stomach." On examining them, they were all found to be desquamating. Their mothers had not noticed this.

Other three children in the school had slight increases of temperature. The school was closed for six weeks, and in a district such as the one under consideration, splendid isolation is secured by closing the school, as the children live at farms far removed from each other. The six cases mentioned were treated as cases of scarlet fever and the disease ran its typical course in all of them. The contacts were disinfected. No more cases occurred in that school, and as I mentioned before, no cases of debility such as occurs after unrecognised scarlet fever have been brought to my knowledge.

One feels quite justified in believing that had it not been for the accidental discovery of these six cases in their early stages, that there would have soon been a wide spread and possibly serious outbreak of scarlet fever amongst the scholars in that neighbourhood; but by the fortunate discovery, it was possible to prevent it spreading, and thus to save a great deal of both immediate and later suffering and ill-health.

ILLUSTRATION VII.

Thornhill/

Thornhill Outbreak.

I shall describe one more outbreak which occurred in the village of Thornhill. This is a village of about a thousand inhabitants. Many of them are of the poor labouring class, and there are a good many instances of large families living in small houses. These are the very conditions that conduce to the development and spread of the disease. There are about two hundred pupils in the school.

In May, 1911, several notifications of scarlet fever in pupils attending the school came in within a week. They were all rather severe cases. There had been no previous cases in the village for several months.

On visiting the school, I learned that all of the cases were from the same class in school, and this decided me to examine every child in that class. I soon came upon a boy who was desquamating very freely in large flakes from his chest. This boy had been in Glasgow three weeks previously on a Saturday, and had visited a family where there had been scarlet fever two months before; but he had not taken ill himself and his attendance at school had been without any interruptions. His mother had not noticed the desquamation/

desquamation from the chest and was positive that there had been no rash. No other child in the class shewed any evidence of having been ill. The boy was removed to the Isolation Hospital and no other cases occurred in the school.

There are some interesting points to note in this case. In the first place, in the house where he was visiting in Glasgow, there had been a case of scarlet fever two months before his visit. This case had been removed to Hospital and the house had been disinfected; but the people who had come in contact with the case before it was removed had not been disinfected, and one of the conclusions I draw from these observations is that contacts are a common and fertile means of spreading infection. They may harbour the infection without themselves being ill, and probably this was where the Thornhill boy got the disease.

This is another instance of what might previously have been considered "house infection", when it was believed that the germs could live on walls or furniture, etc., for a long time. We do not now believe that the germs can live on inanimate objects for any length of time, but we do know that they/

they can be harboured in "carriers" for an indefinite time.

Another point in which this outbreak differs from those previously mentioned is that, although the Thornhill boy had the disease so mild that he never was ill, those children who got the infection from him got it severely. There was not the passage through several persons with a gradual increase in the severity in each case as was observed in those outbreaks that occurred in the sheep farming districts. One feels inclined to ask if it is the difference in the density of population, or the difference in the homes that determines the difference in the behaviour of the germs. I believe both factors combine to produce the effect.

The foregoing are a few examples out of many outbreaks of scarlet fever that have come under my own observation, and with which I have had to deal. They serve to illustrate how the disease gets imported/

imported into neighbourhoods previously free of it, how it spreads, and how the Preventive Officer of Health deals with it. Each outbreak is a new problem to be solved.

There are several instructive points in these outbreaks I have described. In the first place we were able in several instances to say quite definitely where the original infection came from. The Ericstane outbreak was imported from Carlisle, and the Thornhill from Glasgow. The fact of it coming in both instances from large and crowded cities taken in conjunction with our experience of the Annan outbreak, where the disease developed in the slum quarters of the town, lead one to ask if crowding, dirt, and impure air are not the conditions that keep scarlet fever lingering in our midst. If that surmise be correct, then the very measures that are being so vigorously adopted at the present time for the conquest of Tuberculous disease should result in the diminution or abolition of scarlet fever as well.

The following figures on Tables I and II shew that simultaneously with the advance of Sanitary administration, the deaths from scarlet fever have steadily diminished. The periods covered by these tables/

tables are the periods that have seen Public Health work develop.

TABLE I.

Death rates per million of the population in the five groups of districts in Scotland.

	All Scot- land.	Town Districts.			Rural Districts.	
		Principal	Large	Small	Main- land.	Insular.
1871-75	1060	1420	1260	1150	640	260
1876-80	530	500	740	650	420	120
1881-85	350	470	420	390	170	60
1886-90	220	300	200	210	150	60
1891-95	200	280	180	170	120	50

TABLE/

TABLE II.

This Table shews in a diagrammatic form the mortality from scarlet fever per million of the population living in England and Wales from 1856 to 1906. The low rate has continued since 1906. Compared with Table I, which shews the same for Scotland from 1871 to 1895, the figures are approximately the same.

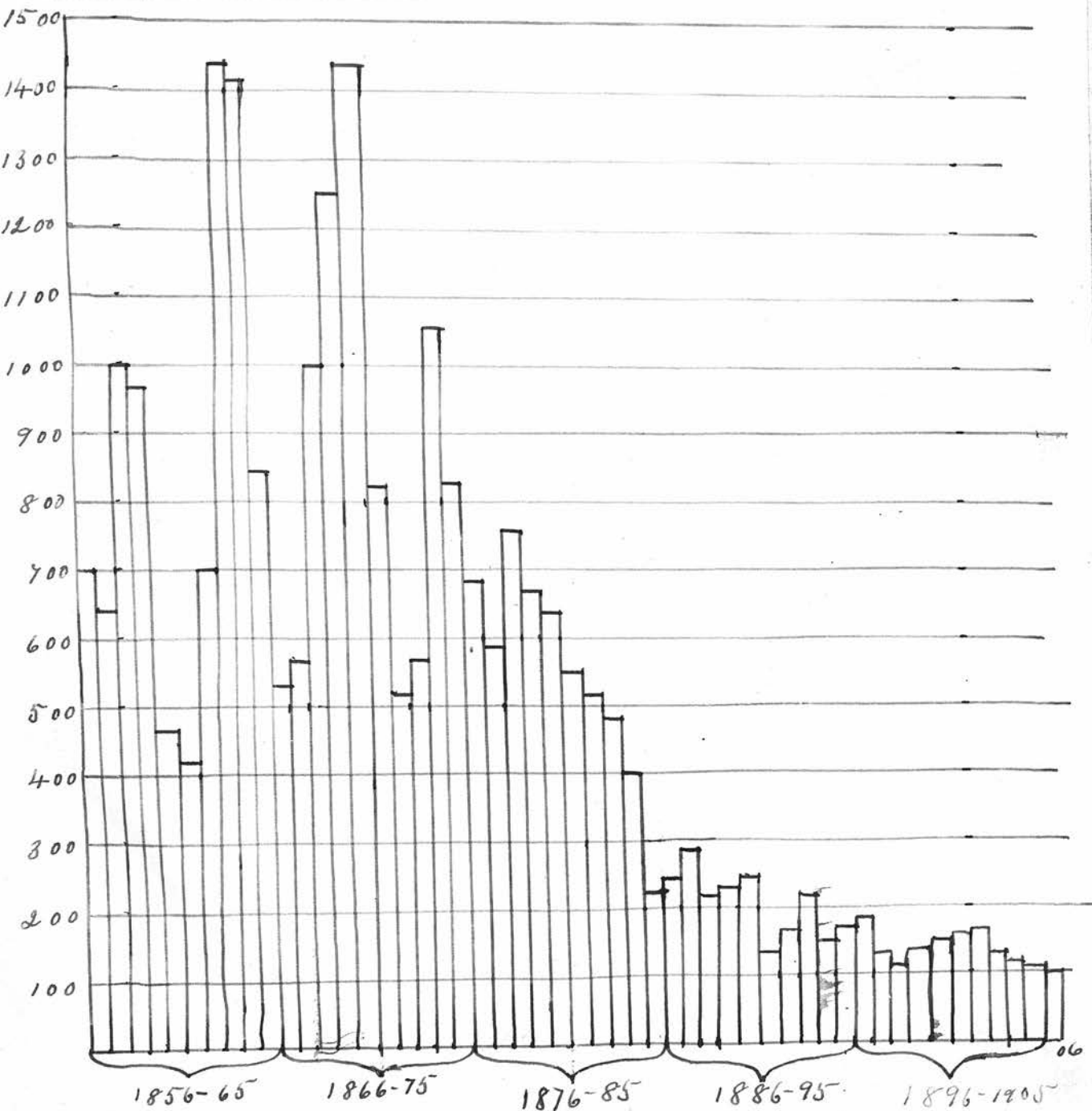


Table I. also shews that the denser the population, the greater is the mortality from scarlet fever. It is high in the towns and low in the rural districts. When a rural community is once free of the disease I believe it remains free till infection is again imported from a crowded centre where the disease is endemic.

Another instructive lesson in some of the outbreaks I have mentioned is that the early cases arising in a district may be of such a mild type that the patient is never ill, the signs may be so slight that they are not noticed, and scarlet fever never suspected. The Ericstane and Tubhill outbreaks both illustrate this point.

But as the disease passes from one person to another each fresh case shews increased severity until it becomes typical and cannot be overlooked. These early atypical cases probably outnumber the later severe ones, but being unrecognised are of course untreated; and it is amongst these cases that after-effects of scarlet fever are most productive of permanent ill-health.

It is also these unrecognised cases that are responsible for spreading the disease to well persons. When scarlet fever is recognised the patient is isolated from contact with his fellows; but an unrecognised /

unrecognised case is, of course, not controlled in any way and mixes freely with his fellows, and such a case is apparently quite as potent in spreading infection as a severe case.

Another very noticeable point is the completeness with which the disease attacks children in a rural district when infection is introduced amongst them. In some of the glens almost every child became infected. Of course one can understand that, if no scarlet fever has occurred in a particular glen for several years all the children who have been born since, are virgin soil and very susceptible. And I am inclined to believe that the converse is the case in cities, and that slum children acquire an immunity. If it attacked children in the poor quarters of towns in the same proportions that it attacks children in rural neighbourhoods the problems in towns would be much more serious than they are.

LATENT DISEASE.

In our undergraduate days we used to be taught that the course of a fever is definitely divided into stages and very exact periods were allotted to each stage. These stages were incubation, invasion, advance, decline, and convalescence. After convalescence the patient was declared to be free /

free of infection and allowed once more to mix freely with his fellows.

I am convinced that in many instances either individual idiosyncrasies, or other factors which we do not yet understand, are capable of very greatly modifying these stages. More especially is this the case at the beginning and the end of the course of a fever.

At the beginning the infection may lie latent for an indefinite period. During this latent period the person feels quite well. There is nothing to indicate that he has infection in his system and he does not infect persons with whom he comes in contact.

We have not yet succeeded in isolating the germ of scarlet fever, but we are justified in assuming that it is caused by an organism or a combination of organisms. Laboratory experiments on other organisms provide us with an illustration of what may be considered latent existence. Typhoid bacilli on culture media kept at a low temperature remain alive but inactive for months. When restored to the suitable temperature they again become active.

Seeds of plants may be kept for years without changing, and when placed in suitable surroundings /.

surroundings of moisture, soil, heat and light, begin to germinate.

Clinically we often see instances of the same phenomena. Gonorrhoea may be to all appearances cured, and for months shew no signs of the presence of the germs; but they again under special circumstances become active and set up a fresh attack of the disease. I believe that scarlet fever in the same way may lie latent for months until circumstances are suitable, when the germs become active and set up fever.

This is, I believe, the explanation of many an outbreak of scarlet fever when no recent exposure to an infectious case can be traced.

This characteristic of the disease is illustrated in the Kirkcudbright case, when the young brother was probably infected long before he got his chill, but the fever did not develop till the chill.

CASES REMAIN INFECTIOUS.

The other point in which the disease differs from what we used to be taught is that the patient may remain infectious long after he has become quite well again.

We used to be taught that the desquamation was the infectious material and that when all peeling had /

had ceased the patient was harmless. But patients were often discharged from hospital, in whom every trace of peeling had long since ceased, and on their return home other members of the family took the disease. This used to be explained as infection by fomites, but even that could often be excluded; and then discharges from nose, ears or open wounds were blamed. Doubtless these discharges, when they are present, are fruitful sources of infection, but many cases occur where no such discharge can be detected, and yet return cases are set up. One is forced to the conclusion that, apart from active discharges, the mucous membranes of some patients continue to harbour the germs long after the fever as an active disease has ceased to exist in them.

Reasoning by analogy from other diseases, this seems quite probable. Some cases of diphtheria continue to give positive cultures for months after the attack, and typhoid patients have been proved to continue harbouring and discharging typhoid bacilli for the remainder of their lives after an attack of the disease. Some of these typhoid patients have this peculiarity, that the discharge of bacilli is intermittant. On examining the stools or the urine/

urine, long periods occur during which no bacilli can be demonstrated, but suddenly they appear again, though of the special cause of their reappearance we are as yet totally ignorant.

A laboratory test (similar to the Weidal for typhoid), which one could apply to determine whether a patient has, or has had scarlet fever would be an invaluable discovery; but in its absence we must be content to study the disease epidemiologically.

I have tried a number of culture experiments from the blood, skin, sweat, urine and throat; and from mucous and purulent discharges of scarlet fever patients in both the early and late stages of the disease, but unfortunately I have not been able to demonstrate anything definite as yet. These experiments I intend to continue. An illustration of this point is found in the Cummertrees case already noted. The boy has long since been free of both desquamation and discharge, but children coming in contact with him continue to contract the disease.

CARRIERS.

With regard to some other infectious diseases,--notably typhoid fever and diphtheria - quite/

quite a revolution in our ideas of their mode of spreading has resulted from the discovery that certain persons are what are named "Carriers". In the "Lancet", 1909, II., 1137, Roscoe reports an instance of twelve cases of typhoid resulting from contact with a "Carrier" who had not himself been sick, and that is one of many such instances that could be quoted.

In the case of diphtheria, the "Carrier" as a factor in the spread of the disease is now so well recognised, that on an outbreak occurring it is our routine practice to examine swabs from the throats of all those with whom the patient has been coming in contact. Very frequently this course is rewarded by the discovery of some one who is harbouring the disease without ever having been ill.

As noted before, the lack of a laboratory test for scarlet fever prevents us from demonstrating the existence in this disease of "Carriers", but epidemiological evidence justifies us in assuming that the same condition prevails.

Chapin in America has published a great many instances, to prove that there are "Carriers" of scarlet fever as well as of the other diseases named./

named, and that the infectivity is also intermittent. This intermittent property, he concludes, gives the key to many otherwise unexplainable outbreaks of the disease.

It was proved in the epidemic of Cerebro-spinal meningitis, which occurred in Edinburgh and Leith a few years ago, that the germ of that disease may live for weeks in the nasal mucous membrane of persons who have come in contact with cases of the disease, though they themselves may not take it. After harbouring the germ for weeks, however, they may pass it on to other persons who immediately fall ill with the disease.

My argument is, that exactly the same thing occurs in the case of scarlet fever. There must be some idiosyncrasy in the individual, or some combination of circumstances, which as yet we do not understand, that determines the development of the fever.

The Ericstane outbreak already described gives a good illustration of a "Carrier". The boy from Carlisle had been in contact with the disease, but had not himself been ill. The length of time that had elapsed since he was exposed to the infection/

infection would have insured that he had recovered from it, if it be argued that he might have been a mild and unrecognised case, but notwithstanding that, he passed the disease on to his cousins when he came to visit them.

Also the Annan case. The boy had not been ill, but whenever he bathed with his companions he passed the disease to them.

CONTACTS.

Closely allied to the subject of the "Carrier" is that of the "Contact", indeed one great aim of this thesis is to emphasise the importance of contacts as agents in the spread of scarlet fever; and the importance of including them when we carry out measures to prevent the spread of infectious disease.

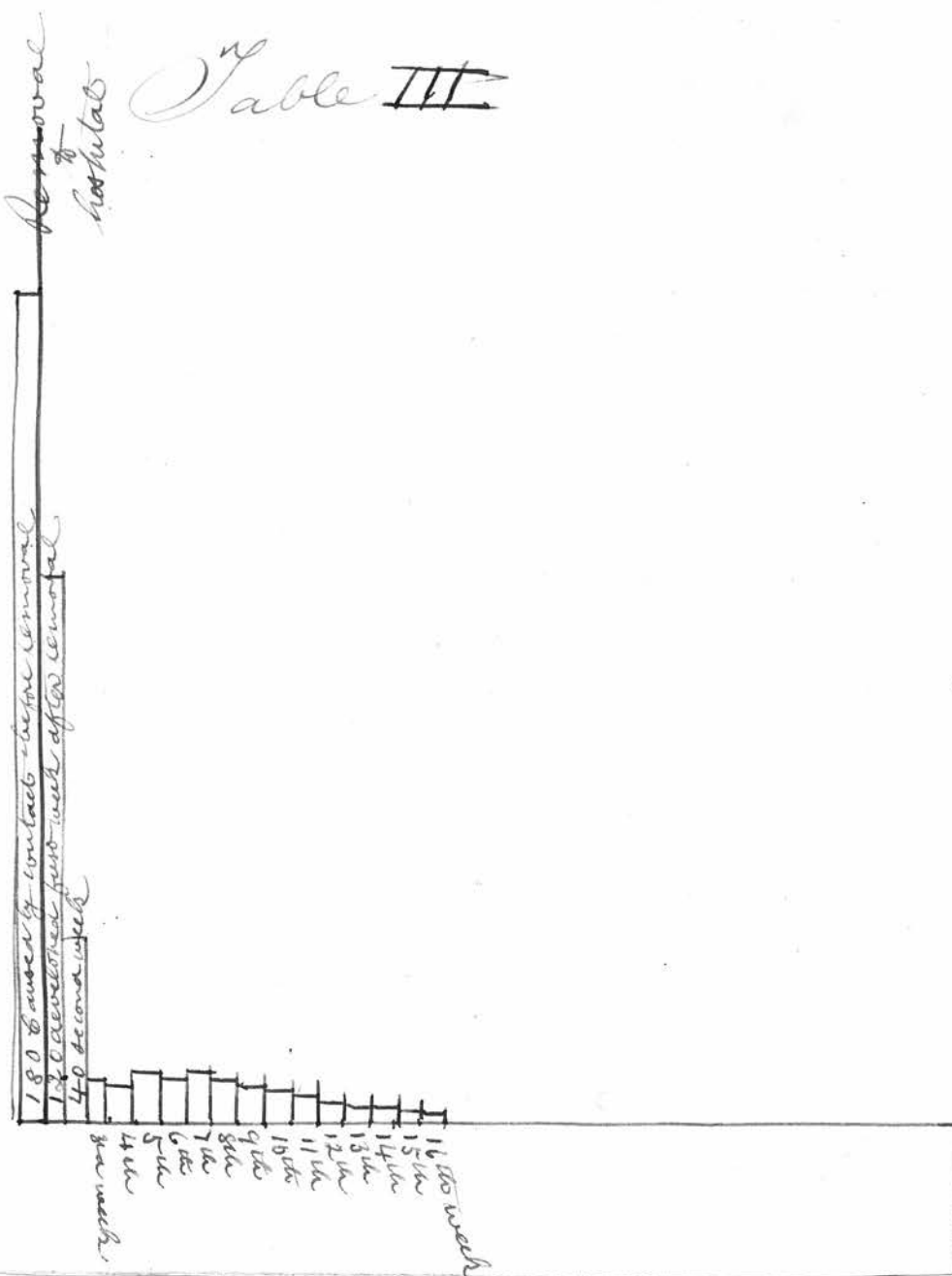
This is already done in the case of an outbreak of small-pox. In that case the seriousness of the disease is held to justify the thoroughness of the measures taken. I quite grant that neither the immediate nor the later effects of scarlet/

scarlet fever can be held to be as serious as those of small-pox, but I do hold that they are sufficiently serious to justify more thorough measures being taken to prevent ~~the~~ infective persons spreading the germs, and this chiefly centres round the question:- "How are we to deal with contacts?" As examples of what I consider to be epidemics started by contacts, I will quote again the Ericstane, the Annan and the Thornhill cases.

In the first, the boy from Carlisle had come in contact with the disease, but had not himself taken it. He must have harboured the infection for two months, and then given it to his cousins.

Table III. /

Table III



Secondary cases per one thousand houses.

This table illustrates the time that scarlet fever infection may lie latent in some persons; and it shews also that if contacts could be efficiently disinfected /

disinfected how much disease might be prevented.

The Medical Officer of Surrey kept under observation one thousand houses from which scarlet fever patients had been removed to hospital. He wished to note secondary cases.

180 Secondary cases developed before the original cases were removed.

120 do do during first week after removal of original cases.

40 do do during second week after removal of original cases.

From the 3rd to the 12th week the number of cases developing weekly was from 10 to 15; and a few cases continued to develop up to the 15th week.

In making these observations it was considered that other sources of infection were excluded.

In the Annan outbreak the same thing occurred. And in the Thornhill outbreak the boy must have been infected from contacts. There had been scarlet fever two months previously in the house where he visited. The case had been removed to hospital and treated, and the house disinfected, but no steps were taken to destroy the germs that may have harboured in the other members of the family.

It is quite evident that for every case of scarlet /

scarlet fever recognised, there must be many more contacts. If it be allowed that all or any of these contacts are capable of harbouring and spreading the germs then it is evident that a tremendous number of possible sources of infection are going about quite uncontrolled and mixing with their fellows. The difference in the treatment of the two diseases probably gives us the key to why isolation in the case of scarlet fever has so signally failed to stamp out the disease, while in the case of small-pox it is so successful.

The plan of isolating the sick from the well until the fever has passed and the patient has ceased to be infectious is quite proper, but the critics of the system quite truthfully point out that isolation has failed to reduce scarlet fever as was hoped would be the case, and they advocate its discontinuence. I believe that what our modern experience teaches is not that isolation should be abolished, but that we must modify both our theory and practice of it.

In the case of a patient from a middle or good class home where he can have a room to himself and can be attended to by a nurse who is to be trusted intelligently to keep her patient from infecting "contacts", I do not consider there is any advantage in /

in removing him to hospital. Indeed in such a case I consider the balance is in favour of keeping him at home.

When in private practice, I followed that procedure for years and do not believe that a single fresh case ever arose from one of my patients.

Of course when the disease occurs in a crowded home where isolation and proper prevention of contact cannot be secured the position is different and removal to hospital is necessary.

Later on I will give my reasons for believing that the air does not convey infection and that therefore there is no danger in nursing a fever patient in any house so long as direct communication between the sick and the well is prevented.

But while arguing that we might very wisely be very much less strict about removing all scarlet fever patients to isolation hospitals, I am strongly of opinion that we should give a great deal more attention than we at present do to those who have come in actual contact with fever patients.

It would of course be impracticable, and, even if practicable, would put those contacts to too great inconvenience, and the public to too much expense /

expense to isolate them, but it would be quite reasonable to insist that every contact must take antiseptic baths and use an antiseptic nasal douche and throat gargle. In some cases that have occurred in my own experience these measures have been sufficient to remove the infection from a contact.

It must be admitted that at present very little is done to prevent the spread of disease by "contacts".

When a case of infectious disease occurs, what usually takes place is as follows:-

On the medical practitioner becoming convinced of his diagnosis, he reports it to the Medical Officer of Health. The Medical Officer visits the house and endeavours to discover a source of the infection. One's experience is that so long as he confines himself to looking for faults in the drains or structure of the house, or to the water or milk supply, or indeed to any source that does not include persons, he gets every assistance and sympathy. But when he suggests examining other members of the family, he does not have the same sympathy and is often met with opposition, and that opposition is more pronounced when he suggests any course which would entail /

entail trouble or interference with the freedom of the other members of the family. In those cases where they have agreed to take the measures one has advised, I am convinced that the spread of the disease has been prevented.

One can quite understand and sympathise with the private medical attendant for not being too ready to give advice which is not asked for. The medical attendant is usually called to see a particular patient. It entirely depends on what standing he has with the family whether or not he feels justified in interfering with other members. One has attended on people who would have told him that he was going beyond his commission in doing so. But even when he does so the practitioner's thoughts are for the treatment of them as individuals and not for prevention of the spread of the disease.

Of course, unless the permission be voluntarily granted, the Medical Officer of Health can deal only with cases actually notified as having the disease. It is therefore quite apparent that contacts, far outnumbering the cases positively diagnosed and notified, go about quite uncontrolled and mix with the public.

EUCALYPTUS OIL TREATMENT.

Anointing with Eucalyptus oil, or, as it is popularly called, "Dr Milne's" treatment has been tried in various of our County Hospitals. These Hospitals are under the charge of the local practitioners and the reports on this treatment are absolutely independent of each other. Some cases under the treatment ran a very mild course, but it has to be remembered that now-a-days many cases, if left alone, scarcely shew any symptoms.

Other cases in spite of the treatment ran quite a typical course. On the whole the reports indicate that this treatment does not seem to be of any apparent value.

INJECTIONS.

Some anti-toxic sera for injection into scarlet fever cases have been introduced and highly praised by the makers, but I have seen no beneficial results following their use, and the fact that such treatment has not found favour in the profession justifies one, I think, in saying that as yet none of the serum treatments are of any practical value.

TYPE OF DISEASE BEING MODIFIED.

Another point that impresses itself on me on reviewing my work with scarlet fever during the past /

past few years is that the usual type of the disease as seen now-a-days is very different from what it formerly was. In one's undergraduate days we were taught what the symptoms of the disease were, and when we were taken to the bedside in the fever hospital these symptoms in the various stages of the disease were demonstrated without difficulty. Now-a-days it is rarely that we get typical symptoms. The rash is usually faint and short-lived; the strawberry or strawberry and cream tongue is seldom seen, and throats are often merely slightly congested, and slightly painful. Desquamation is also a most unreliable symptom. It is often absent or present in a very uncertain fashion.

Practitioners tell me that they are oftener in difficulty in coming to a decision as to whether or not a case is scarlet fever than with any other disease.

The explanation of this change in type is of course doubtful, but I believe that it is owing to the very thorough isolation of the disease that obtains now. Practically every pronounced case is either sent to hospital or isolated at home till it ceases to be infectious. Although we have done nothing definite /

definite towards isolating the germs of scarlet fever we are justified in assuming that it is caused by a germ or some combination of germs. It is quite proper to assume that when every typical case is isolated till the germs die that the stock remaining to propagate the disease will be the less virulent and less typical breed. If that be so, it puts a great deal to the credit of isolation.

PART PLAYED BY INSECTS IN THE SPREAD OF DISEASE.

With regard to the part that insects play in the spread of infectious disease what definite knowledge we have has been acquired during the past twenty years or so and that knowledge chiefly relates to Tropical diseases. The epidemiological observations and laboratory experiments that have proved our facts so far comprise some of the most brilliant work in the history of medicine.

In this country the subject has been studied chiefly in relation to typhoid fever and summer diarrhoea.

It is evident from various writers that for a long time insects have been suspected of being agents in the spread of some diseases, but not till about /

about 1885 or thereabouts was definite proof offered.

With regard to Tropical diseases such as Malaria, Yellow Fever, Sleeping sickness and some others, it has been shewn that the particular insect concerned is a necessary host in which a phase in the life history of the disease germ occurs. In such cases the insect is what may be called a biological agent in the spread of the disease.

In this country we are still in doubt as to whether the insects are such true biological agents or merely mechanical carriers.

If it ever be proved that they act as hosts to the germs of any of our infectious diseases then a new light will be thrown on the cause of otherwise inexplicable outbreaks of disease.

But while admitting the possibility of this I have as yet failed to find any evidence that can induce me to entertain the belief.

That insects often act as mechanical carriers of disease is, I think, satisfactorily proved.

Dutton in Chicago considered he had proved that bedbugs acted as biological carriers of typhoid, when he observed that their coming from a typhoid patient and biting a healthy person set up the disease in the healthy one. But later observers have shewn /

shewn that these insects carry the typhoid bacilli adhering to the outside of their bodies. So when the bedbug bites a healthy person, the likelihood is that the bite gets inoculated from the body of the insect.

In such a case the bedbug must be considered as a mechanical carrier between a sick and a well person, and is in the same category as a dirty instrument, or the unsterilised hands of a nurse.

It is easily conceivable that head and body lice, and fleas may play the same part as bedbugs.

House flies have also been proved to be mechanical carriers of disease. As laboratory experiments, sterile milk and jellies have been exposed alongside of tubercle and typhoid infected foods. Flies were allowed free access to both, and the milk and jellies were soon infected.

In private houses using privy middens, food has been found with typhoid bacilli on it when there was a case of that disease in the near neighbourhood. The likely explanation of this was that flies had been the mechanical carriers.

In applying these observations to scarlet fever one has to admit that we have no proof that insects spread the disease. But I think we are justified in assuming that the disease depends on either a specific /



specific germ, or a specific combination of germs. Also that the germ lives in one or more of the mucous membranes and leaves the patient by one or other of the fluid discharges. It may be in the saliva, sweat, urine, or pus. If that assumption be correct, I see no reason why insects may not be the mechanical carriers of scarlet fever as of other diseases.

In any case it is desirable that medical officers of health should give attention to the prevention and destruction of insects.

Burning the unexpanded flowers of chrysanthemum along with valerian root is a powerful deterrent of the house fly.

OLD BELIEFS TO BE DISCARDED.

What has been written in the foregoing pages is intended to prove that scarlet fever, judging from the light that our present knowledge sheds on it, is a disease of the human being and is spread from person to person. In previous years certain beliefs as to the origin and spread of the disease were very generally accepted; but I believe that these have no foundation to justify their acceptance.

The first of these that I will mention is that the cow, and possibly some other lower animals, suffer from scarlet fever and may communicate it to man /

man. There are several recorded instances of epidemics of scarlet fever following the use of milk from dairies where the cows had a disease which was said "to resemble scarlet fever". In no instance, however, which I have been able to refer to was the evidence satisfactory that the disease was the same, and the opinion of veterinary surgeons is decidedly against the belief that cows suffer from scarlet fever.

I am endeavouring as far as possible in this thesis to avoid quoting from the work of others, but to offer evidence from cases that have actually occurred in my own experience. I have all along been on the outlook for evidence that could point to scarlet fever being a disease of the lower animals, but so far with negative results. Many of the instances I have described occurred at farms where the patients were working amongst cows and other animals, and in such cases I have made it a rule to enquire about illness amongst these.

At Ericstane, already instanced, a cow calved and took puerperal fever. The posterior half of the udder was swollen and hard; the anterior half was not. The man who milked the cows had been taking the milk from the posterior two teats and giving it to the pigs, but he thought that, as the anterior half /

half of the udder was soft, the milk from the anterior two teats might be safely used. Accordingly he had been mixing that milk with the milk from healthy cows and it was distributed to the people at the farm.

It was the case that some three or four days after the first distribution of this mixed milk, the first case of scarlet fever was notified from the glen. On first thoughts I felt that here was a case where some connection between fever in the cow and scarlet in the human being might be inferred, but on reviewing the epidemic after full investigation, it was clear that mild and unrecognised cases of scarlet fever had existed amongst the children, long before the cow was ill. Had these previous cases not been demonstrated I would probably have suspected some connection, but having convinced myself of the existence of these previous cases I felt compelled to believe that the cow was not the source of the disease.

I am not arguing that milk cannot carry the germs of infection. There is ample proof that milk is a suitable medium for the germs to live in and can be the means of spreading the disease. I will treat *of* that later when speaking of "food". All I mean to argue here is that scarlet fever has not been shewn to be a disease from which the cow suffers, and that we /

we have no proof that the disease is transmitted from the cow to man. Our evidence goes to prove that so far as we know scarlet fever is a disease of the human being.

Another interesting instance of human beings and animals being ill at the same time from an apparently similar disease occurred in the village of Gretna. A boy was notified as having scarlet fever, and I also found that his sister was in the same condition as he, but not so severely.

In the house was a litter of retriever pups about six weeks old, several of which had been suffering from inflamed throat since before the children were ill. I took swabs from the throats of both puppies and children and made cultures, but on examination of the cultures I could find nothing to indicate that the conditions were due to the same organism.

And so again I was forced to the conclusion that in this case no connection could be proved between the illness in the children and the illness in lower animals.

HOUSE INFECTION.

Another belief which used to be quite generally accepted, but which I consider can no longer be entertained, is that "houses" become infected and that persons /

persons living in such a house may get the germs from the building. This is still believed by many with regard to tubercle bacilli, but even with it, recent investigations tend to discredit the belief.

Twelve years ago when I was an assistant in Lincolnshire there was a small farmhouse in particular which was popularly known as "infected". Almost every domestic who went there took scarlet fever. During the year I was in that assistantship there were three cases from that house. At that time I quite believed that the house harboured the infection, but the discovery of latent cases and carriers in other diseases, and the epidemiological observations which shew the likelihood that scarlet fever also has latent cases and carriers, make it much more likely that the cases from that farm were due to such a carrier, and very unlikely indeed that the building had anything whatever to do with harbouring the infection. One feels confident in believing that if we had had a bacteriological test for proving scarlet fever that an examination of the inmates of that farmhouse would have discovered a "carrier".

The Cummertrees cases, described in an earlier part of this thesis is another instance of what would /

would formerly have been considered "house infection" but which must now be considered due to a person harbouring the germs for an unduly long time.

INFECTION by FOMITES .

Closely allied to the belief in infected houses is the belief in infection by "fomites".. In talking to Medical Officers of Health and more pronouncedly when talking to Medical Practitioners, I find that this word does not have a very clearly defined meaning. I will endeavour to shew what I understand by the term. For an instance, if a school child puts his pencil in his mouth and then passes it to his neighbour who puts it in his mouth, and ~~the~~ ^{thus} disease germs pass from number one to number two, that would not be infection by fomites, but by indirect contact. If however number one after putting the pencil in his mouth laid it aside for several months, and after that time number two put it in his mouth and took the disease it would be an instance of infection by fomites. It implies the power of the germs to live and to retain their pathological properties for weeks or months on such articles as walls, furniture and clothing.

A friend who is Medical Officer of Health for

a neighbouring district to this, some years ago was much exercised over some "return" cases of scarlet fever.

One case was that of a patient who, after returning home from hospital, wore some clothing which had been packed away since the time when he went off. When that clothing was brought out and worn, another case of scarlet fever developed in the house. It was concluded that these clothes had harboured the infection all the time that the patient was in hospital. This, my friend then considered a case of infection by "fomites", but he does not so regard it now. He considers it a case of lingering infection *in the patient.*

He has investigated many such cases of supposed infection by fomites, but personal contact with infectious persons could never be excluded.

The science of bacteriology has shewn us how unlikely it is that germs live on such media as walls and furniture for any great length of time.

Probably the germ of each infectious disease has its own life history and its own characteristics, but all have a good deal in common.

Many of the recognised germs can be cultivated outside the body only with great difficulty, others can be kept alive only for a limited time, and even /

even on carefully prepared nutrient media with temperature and other conditions carefully regulated, I do not think that there are any pathological germs that can be preserved for an indefinite time. How unlikely therefore it is that walls, furniture, clothing, with changing conditions of temperature, light and moisture should serve to preserve these germs for the great length of time that they used to be credited with doing.

It is probable that in moist discharges the germs retain their vitality for a moderate time (apparently a few days is the limit for most) and if transferred to a healthy person, are capable of setting up the disease, but that again is better described as "indirect contact" than as infection by "fomites".

In connection with the disbelief in "infected houses" and infection by "fomites" I will here state that the value of disinfection of buildings, as practised, is greatly over-rated. The germs themselves soon die without any disinfectant, and it seems very doubtful if the disinfectant as used kills the spores.

Also it gives the public a false sense of security.

Cleanliness of persons and things, fresh air /

air and sunlight are the best disinfectants, and these should be aimed at more and fumigation relied on less.

GERMS NOT AIR BORNE.

It used to be taught that infection was capable of being carried by air currents for distances even as far as a mile. Smallpox especially was supposed to be spread in this way. This was before the bacteriologist had given us the definite knowledge that we now possess of germs and their properties. Of late years the belief in air borne infection has been weakened as, when cases have been investigated, connection with "contacts" is usually proved, and we now know that "contacts" are liable to be "carriers". Seldom can the possibility of such contact infection be excluded.

Also the facts learned about germs make air infection exceedingly unlikely. Travelling by air currents entails exposure to fresh air and light - the very agents most fatal to the life of bacteria.

Of course bacteria may be carried from a sick to a well person on a particle of moisture or mucus when the sick person coughs, but that could not be called air-borne. That is another example of indirect contact, and occurs across a very limited distance.

The theory and practice of modern surgery teaches us a great deal about the pus-forming bacteria. Probably each micro-organism has its own life history and its own individual properties but on the other hand much is common to all bacteria, and I think we are justified in concluding that much of what we have learned of the pus-forming organisms may be taken as equally applicable to the organisms of the infectious diseases in general.

Within one's own recollection the practice of surgery has been revolutionised through our increased knowledge of bacteria.

Twenty years ago germs were supposed to infect a wound from the atmosphere. Now the surgeon does not fear germs from the air, but he does fear infection direct or indirect from a person. His aim is to prevent it being carried to the wound from another person. Owing to the very enlightened ideas held by the modern surgeon, when a wound, which was previously clean, becomes septic he knows that septic matter has been carried to the wound, and for that someone is to blame. It is a preventable accident.

Unfortunately the physician has not mastered the principles of asepsis as the surgeon has. The spread of infectious disease is quite on a par with the /

the spread of sepsis; every new case of fever means that a well person has been in contact with an infectious one, but the physician does not take any blame to himself when infection spreads from the sick to the well. Undoubtedly the surgeon has got far ahead of the physician in solving the question of "How are we to prevent the spread of infection?"

I have seen a practitioner, when dressing a small cut in a hand, taking the most elaborate precautions, and quite properly, to prevent the wound becoming septic; and at another time have seen the same gentleman touch a scarlet fever patient and leave the house without even washing his hands.

I am mentioning this to illustrate the different mental attitude that exists in the profession towards surgical and medical asepsis. The practitioner has learned his lesson with regard to surgery, but he has not grasped the fact that medical infection also has to be passed from the sick to the well either directly or indirectly, and that such passage must be prevented if we would check the spread of infectious disease. And of course when members of the profession so often neglect precautions to prevent medical sepsis, we cannot expect the public to realise the importance of attending to them.

Further /

Further evidence that scarlet fever is spread by contact and is not air-borne is got from the practice which French physicians are following of nursing the various infectious diseases in the same ward. Every care is taken to prevent contact, either direct or indirect, and cases of cross infection are almost unknown.

"At the Pasteur Hospital from October 1st 1900 to April 19th 1903 the following cases were received - Diphtheria 443, Scarlet fever 92, Sore throat 166, Erysipelas 163, Smallpox 524, Chickenpox 55, Measles 126, Other diseases 219, Mothers with infants 192. There was no attempt to keep the different diseases in separate wards. If infection were air-borne, there should be a great deal of cross-infection amongst these cases. During the two and a half years the only new cases of disease that developed in the Hospital were 5 of smallpox, 2 of erysipelas, and one of diphtheria. Since 1904 the percentage of cross infection has been less than .1%."

Other French Hospitals get results which corroborate those figures, and I think justify one in ceasing to believe that infection is air-borne.

INFECTION by FOOD.

Much attention has been given to the spread of /

of scarlet fever by food, and of all the articles of food, milk is the most important. Many convincing instances have been published of such spread by milk, but as I am wishful, in this thesis, to confine myself to instances that have occurred in my own experience, I shall describe one. It occurred at a small farm where only two cows were kept, and where the milk was all disposed of amongst the neighbours. Several cases were notified amongst the users of this milk, and a systematic examination was made by me of all the people about the farm. A boy who helped in the dairy and who delivered the milk was discovered to be desquamating. He had never been ill and no one had suspected him of being the source of the infection. After he was removed to hospital no more cases occurred there.

This is quite a good illustration of what is meant by an epidemic of scarlet fever being caused by milk. But let us define clearly the part that the milk plays. It is admitted that the organisms live for a certain length of time and retain their virulence. That they multiply has not been proved. Nor, so far as I have been able to discover, has it been shewn that they live for any great length of time, as the recorded instances refer to the distribution of new /

new milk for immediate consumption.

After all, the milk is not responsible for the disease. It is simply the bridge in an indirect contact. Though indirect, it is still infection by contact from person to person, and it emphasises the need for the Preventive Medical Officer giving his attention to the individual. This officer should be a person with great clinical experience of infectious disease so as to be able to detect every symptom that would indicate a "carrier". In the past it has been the custom of that officer to pay too much attention to surroundings and too little to the individual.

All the milk-spread epidemics of scarlet fever that I have seen or read of have been traced to either (1) cases purposely concealed, (2) mild and unrecognised cases, or (3) cases that have remained infectious for much longer than the usual time. In no case that I know of is there evidence that scarlet fever is other than a human disease, or that infection is other than from one person to another.

In this County there is a great deal of milk produced. The dairies vary much both in size and equipment. Some are conducted on the most scientific principles. Buildings are clean, ventilated, and heated. The workers who handle the milk are trained in /

in all known methods to keep the milk free from contamination. I do not know of a single instance of milk from such a dairy spreading scarlet fever.

On the other hand some of the smaller farms leave much to be desired in their methods. All the cases of milk-spread scarlet fever I have experienced have been from such dairies. It is the clear duty of the Health Official both to educate and compel enlightened methods to be followed in all dairies.

Pure milk kept pure is ever so much more desirable than the sterilised article. The concensus of opinion is that infants fed on sterilised milk do not thrive so well as on the unsterilised, and it is certainly not so palatable.

OTHER ARTICLES OF FOOD.

In one case that came under my own observation, bread was pretty clearly shewn to be the article that carried the scarlet fever from the sick person to the well. And in another case it was cooked meat. One can easily conceive of these articles carrying the bacteria and keeping them alive.

In another instance we found a boy who worked in a butcher's shop to be in an infectious state. We did not trace any fresh cases to him however. Probably he may have infected the meat he touched and one /

one can readily conceive that meat would act as a suitable medium, but the cooking would kill the bacteria.

WATER.

So far as I know water has not been shewn to be a medium that spreads scarlet fever though other diseases are undoubtedly spread by it. But even in these diseases the water is merely the bridge in indirect contact between person and person.

SUMMARY /

SUMMARY.

In conclusion I submit the following points as a summary of the foregoing thesis:-

1. Scarlet fever unrecognised or untreated is responsible for a great deal of ill-health in after life.
2. Isolation has greatly modified the type of the disease. Now the death rate is low. While it used to be 20 per cent of the cases, it is now 2 per cent; but the incidence of the disease is not any lower. This indicates a milder type of the disease and consequently a greater likelihood of cases being unrecognised.
3. Scarlet fever has not been proved to occur in any but the human subject. In particular it has not been proved that it is a disease of the cow.
4. The disease spreads from person to person. This spread is usually direct. If indirectly/

indirectly spread by an inanimate object the time during which the infection can retain its virulence on that object is not long.

5. A person may carry the disease from a sick to a well person and never take the disease himself. Therefore contacts should be disinfectd.
6. A person may have the disease so mildly that he is quite unaware of the fact. Such persons play a great part in the spread of the disease. Therefore such mild cases should be carefully looked for and suitably treated.
7. A person who has had the disease may remain infectious for an indefinite time, and the power of transmitting the infection is intermittent. We do not understand the combination of circumstances that governs this intermittency.
8. A person may harbour infection for an indefinite time before the fever develops.

9. A very mild type of the disease is often introduced into a susceptible community, and by passing through successive persons the disease gains in virulence. On the other hand a mild case may give rise to a severe one directly. Mild cases of scarlet are often mistaken for some other disease.
10. Rural districts are often free of the disease for years, and in these cases the children are very susceptible. On the other hand, in cities where the disease is more or less endemic, it is probable that the children acquire a certain amount of immunity.
11. Scarlet Fever infection is not air borne.
12. The theory that houses may become infected is no longer tenable, and infection by fomites is possible for only a short interval of time.
13. Spread of infection by food is not a serious factor with scarlet fever. Milk is the most dangerous article of food, and it must first of all be infected from a person, so it is really indirect personal infection.

14. Disinfection of premises has not the value it is credited with. Disinfection of contacts and carriers is very much required.
15. Treatment by inunction and injection is not yet proved to be of much value.
16. Insects are biological carriers of some tropical diseases. In this country they are mechanical carriers of disease, but are not yet proved to be biological carriers.
17. Asepsis should be as carefully attended to by the physician as it is by the surgeon.

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